



SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) - SEMESTER TWO
END OF SEMESTER EXAMINATION
ALTERNATE

COURSE CODE : CHM112
COURSE TITLE : General Chemistry I
LECTURER(S) : Jada-Ann Vite'
DATE :
TIME :
DURATION : 2 Hours
STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- This paper has 2 compulsory sections. Answer ALL questions on this paper.
- Section 1 consists of 40 multiple choice questions.
- Section 2 consists of 2 short answer questions.

Section	Number	Marks Earned	Moderated Mark	Maximum Marks
Section 1	1-40			40
Section 2	1			10
	2			10
Total				60

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Section A – Multiple Choice Questions – Each question is worth 1 mark each.

Instruction: Shade the correct answer.

- Which of the following is NOT a relationship between mass, moles, and molar mass?
 - $\text{Moles} = \text{Mass} \times \text{Molar Mass}$
 - $\text{Moles} = \text{Mass} / \text{Molar Mass}$
 - $\text{Mass} = \text{Moles} \times \text{Molar Mass}$
 - $\text{Molar Mass} = \text{Mass} / \text{Moles}$
- Which of the following best defines mass concentration?
 - Moles of solute per liter of solvent
 - Kilograms of solute per liter of solution
 - Grams of solute per liter of solution
 - Grams of solvent per liter of solution
- How many moles are in 32.56g of Na?
 - 2.10g
 - 1.14g
 - 1.42g
 - 0.962g
- How many grams of NaOH are needed to prepare 250 mL of a 0.8 M solution?
 - 8.0 g
 - 18.0 g
 - 15.0 g
 - 28.0 g
- If 0.40 g of a diprotic acid reacts completely with 25 mL of 0.2 M NaOH, what is the molar mass of the acid?
 - 40 g/mol
 - 80 g/mol
 - 160 g/mol
 - 200 g/mol
- A hydrate of $\text{MgCl}_2 \cdot x\text{H}_2\text{O}$ is heated to remove water, leaving 47 g of anhydrous MgCl_2 from an original 80 g sample. What is the value of x?
 - 2
 - 4
 - 6
 - 8
- Which of the following factors decreases the first ionization energy of an atom?
 - Greater nuclear charge
 - Increased distance of outer electrons from nucleus
 - Reduced shielding by inner electrons
 - More valence electrons
- Which of the following molecules has a bond angle less than 109.5° ?
 - NH_4^+
 - H_2O
 - CH_4
 - CO_2

9. Which electronic configuration represents a Z^{2+} ion with 24 protons?
- $[\text{Ar}] 3d^4$
 - $[\text{Ar}] 3d^6$
 - $[\text{Ar}] 3d^5$
 - $[\text{Ar}] 3d^3$
10. What type of bonding is present in NH_3BF_3 ?
- Ionic
 - Covalent
 - Dative
 - Metallic
11. Which statement is true about the bonding in SO_4^{2-} ?
- All bonds are ionic
 - It contains polar covalent single bonds
 - It has resonance structures with covalent bonds
 - It contains hydrogen bonding
12. Which of the following factors accounts for the high melting point of SiO_2 ?
- Van der Waals forces
 - Covalent bonding in a giant lattice
 - Ionic bonding
 - Hydrogen bonding
13. Which of the following pairs of elements would form the most polar bond?
- Na and Cl
 - F and Cl
 - Mg and Br
 - C and H
14. The simplest formula for a compound that contains 50% S and 50% O by mass is
- SO
 - SO_2
 - S_2O
 - S_2O_4
15. The second ionization energy of calcium is 1150 kJ/mol. Which of the following equations represents this statement?
- | | kJ/mol |
|--|--------|
| A. $\text{Ca}_{(\text{g})} \rightarrow \text{Ca}^{2+}_{(\text{g})} + 2\text{e}^-$ | -1150 |
| B. $\text{Ca}^+_{(\text{g})} \rightarrow \text{Ca}^{2+}_{(\text{g})} + \text{e}^-$ | -1150 |
| C. $\text{Ca}_{(\text{g})} \rightarrow \text{Ca}^{2+}_{(\text{g})} + 2\text{e}^-$ | +1150 |
| D. $\text{Ca}^+_{(\text{g})} \rightarrow \text{Ca}^{2+}_{(\text{g})} + \text{e}^-$ | +1150 |
16. Which of the following elements has the highest first ionization energy?
- Sodium
 - Magnesium
 - Chlorine
 - Fluorine
17. Which of the following ions has the largest radius?
- Na^+
 - Mg^{2+}
 - F^-
 - Cl^-

18. The isotopes of an element have:
- A. The same number of neutrons but different numbers of protons
 - B. The same number of protons but different numbers of neutrons
 - C. The same atomic mass but different atomic numbers
 - D. The same number of neutrons and protons
19. Which of the following species has a structure with a bond angle of 120° ?
- A. NF_3
 - B. NH_3
 - C. CH_4
 - D. BF_3
20. Which of the following is **NOT** true about the principal quantum number (n)?
- A. $n = 1$ has one sublevel called $1s$
 - B. $n = 2$ has two sublevels called $2s$ and $2p$
 - C. $n = 3$ has three sublevels called $3s$, $3p$, and $4s$
 - D. $n = 4$ has four sublevels called $4s$, $4p$, $4d$, and $4f$
21. The bond angles in the PH_3 molecule are the same as that of NCl_3 . Its shape would BEST be described as
- A. Trigonal Bipyramidal
 - B. Trigonal Pyramidal
 - C. Tetrahedral
 - D. Trigonal
22. Which of the following is a characteristic of metallic bonding?
- A. Delocalized electrons
 - B. Strong electrostatic attraction between positive and negative ions
 - C. Discrete molecules
 - D. Presence of only non-metals
23. Which of the following characteristics of oxygen BEST explains why the first ionization energy of oxygen is lower than that of nitrogen?
- A. A smaller atomic radius
 - B. Greater shielding by inner electrons
 - C. Greater effective nuclear charge
 - D. Repulsion between the paired $2p$ electrons
24. Which of the following molecules has a permanent dipole.
- A. CH_4
 - B. CCl_4
 - C. CO_2
 - D. HCl
25. The van der Waals forces consist of
- A. Permanent dipole-permanent dipole interactions
 - B. Induced dipole-induced dipole interactions
 - C. Permanent dipole-induced dipole covalent interactions
 - D. Dipole-dipole; dipole-induced dipole ionic interactions

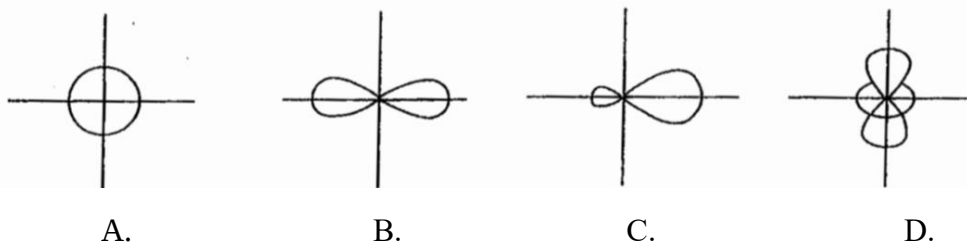
26. What shape describes the molecule water?

- A. Linear
- B. Trigonal planar
- C. Tetrahedral
- D. Bent

27. What is the main intermolecular force in ammonia?

- A. Van der Waals
- B. Dipole-dipole interactions
- C. Hydrogen bonding
- D. Ionic bonding

28. Which of the diagrams below BEST represents an sp^3 orbital?



29. Which of the following best describes a pi bond?

- A. End-on overlap of p orbitals
- B. Sideways overlap of p orbitals
- C. Overlap of an s and p orbital
- D. Combination of an s and d orbital

30. Which of the following is the configuration of Cu^{2+} ion?

- A. $[\text{Ar}] 3d^{10}$
- B. $[\text{Ar}] 3d^8 4s^2$
- C. $[\text{Ar}] 3d^9$
- D. $[\text{Ar}] 3d^{10} 4s^1$

31. The intermolecular forces which are present in ice are

- A. Ionic bonds
- B. Covalent bonds
- C. Hydrogen bonds
- D. Van der Waals forces

32. The valence electrons for a Fe atom are found in the

- A. 3s orbital
- B. 4s orbital
- C. 3p orbital
- D. 4p orbital

33. This question refers to the following standard enthalpies of combustion for carbon, hydrogen and octane.

ΔH_c°	kJ/mol
Carbon	-394
Hydrogen	-286
Octane	-5476

The standard enthalpy of formation of octane, ΔH°_f is calculated using

- A. $\Delta H^\circ_f (\text{octane}) = -8(-394)-9(-286)-5476$
 - B. $\Delta H^\circ_f (\text{octane}) = -8(-394)-9(-286)-(-5476)$
 - C. $\Delta H^\circ_f (\text{octane}) = 8(-394)+9(-286)-(-5476)$
 - D. $\Delta H^\circ_f (\text{octane}) = 8(-394)-9(-286)-(-5476)$
34. Which of the following reactions represents the enthalpy of hydration?
- A. $X(g) + Y^-(g) \rightarrow XY(s)$
 - B. $XY(s) \rightarrow X^+(aq) + Y^-(aq)$
 - C. $X(s) + \frac{1}{2} Y_2(g) \rightarrow XY(s)$
 - D. $XY(aq) \rightarrow XY(s)$
35. The type of bond predicted to be formed between the following pairs of elements is identified correctly EXCEPT for
- A. P and Cl ionic
 - B. H and S covalent
 - C. C and F covalent
 - D. Ba and O ionic
36. A reaction that absorbs heat from the surroundings is classified as:
- A. Exothermic
 - B. Endothermic
 - C. Spontaneous
 - D. Catalyzed
37. Which of the following describes an endothermic process?
- A. Freezing water
 - B. Condensing steam
 - C. Melting ice
 - D. Burning wood
38. Which of the following processes is always exothermic?
- A. Ice melting
 - B. Water Boiling
 - C. Combustion of methane
 - D. Evaporation of ethanol
39. Which of the following statements about graphite is correct?
- A. It has delocalized electrons, making it conductive.
 - B. It only has covalent bonds and does not conduct electricity.
 - C. It has a tetrahedral structure like diamond.
 - D. Its weak intermolecular forces result in a low melting point.

40. What is the empirical formula of a substance made up of 62.0% C, 10.4% H, and 27.5% O by mass?
- A. CHO
 - B. C₂H₄O
 - C. C₃H₆O
 - D. C₄H₇O

Section 2 – Each question in this section is worth 10 marks.

Instruction: Answer all questions in the spaces provided.

Question 1

A student carries out an experiment to determine the enthalpy change of combustion of glucose.

In the experiment, 0.831 g of glucose is burned. The energy released is used to heat 100 cm³ of water from 23.7 °C to 41.0 °C.

- (a) Calculate the energy released, in kJ, during combustion of 0.831 g glucose.

The specific heat capacity of water = 4.18 J g⁻¹ K⁻¹. Density of water = 1.00 g cm⁻³.

Energy = kJ

[2 marks]

- (b) Calculate the amount, in moles, of glucose that is burned.

Amount = mol

[2 marks]

(c) Calculate the enthalpy change of combustion of glucose. Give your answer to three significant figures.

$$\Delta H_C = \dots\dots\dots \text{kJ mol}^{-1}$$

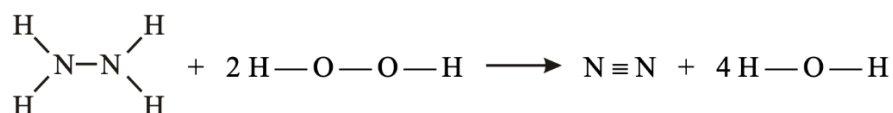
[2 marks]

(d)

Some mean bond enthalpies are given below.

Bond	N-H	N-N	N≡N	H-O	O-O
Mean bond enthalpy/kJ mol ⁻¹	388	163	944	463	146

Use these data to calculate the enthalpy change for the following gas-phase reaction between hydrazine, N₂H₄, and hydrogen peroxide, H₂O₂



[4 marks]

Question 2

(a) Draw, name and explain the difference between the shapes of NH₃ and NH₄⁺ commenting on the angle & repulsion which exist.

[4 marks]

(b) Each of the statements labeled (i) to (ii) below lists some physical properties of a pair of substances. For each of the statements below:

- Identify the types of forces operating.
- Account for any differences in the strengths of these forces and relate the nature and strength of the forces to the properties indicated in each pair.

(i) **CO₂ and SiO₂** are both covalent molecules. However, CO₂ is a gas and SiO₂ is a solid with a high melting point.

[2 marks]

(ii) **Sodium and aluminum** are both metallic elements. Sodium melts at 98 °C and aluminum melts at 660 °C.

[2 marks]

(c) Write electronic configurations for the following:

i. O²⁻

[1 mark]

ii. Cr³⁺

[1 mark]

END OF EXAMINATION